SpyBox manual

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SpyBox manual

by Juan Diez Perez, Stanislas Pinte, and Darius Blasband

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Introduction

This document describes the SpyBox recording device.

The scope of the SpyBox device is twofold:

- capture Profibus traffic from one or two Profibus buses
- capture GSM-R traffic from one up to 4 serial lines

Chapter 1. Concepts and definitions

The following explains the basic concepts related to the SpyBox application. It only provides a superficial explanation, and links to more complete information are provided at the end of this document, indicated by footnotes references.

1.1. Profibus EN50170 Sync Time

A continous period of time where nothing is transmitted on the Profibus physical media.

Acording to EN50170, a Profibus Master station holding the token must wait this amount of time before sending a frame other than a Token or an Aknowledge Frame.

1.2. Off Line recording

An operating mode of the SpyBox where the captured Profibus network data is continously recorded on the SpyBox local CompactFlash card.

1.3. On Line recording

An operating mode of the SpyBox where the captured Profibus network data is continously acquired and sent to the TrippleFSniffer application through the Ethernet link.

1.4. Profibus

The transmission medium used to communicate between devices. Full specifications can be found here [http://www.profibus.com/].

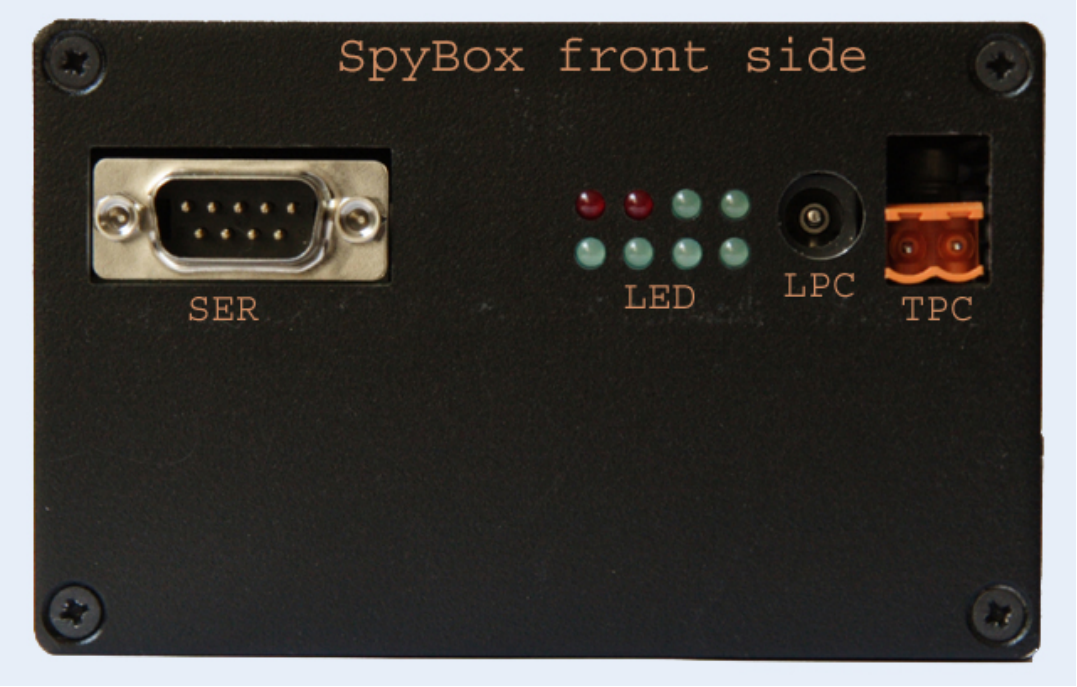
Chapter 2. Item check list

The SpyBox is delivered with

- The SpyBox itself preconfigured with the latest firmware. An embedded pre-configured CompactFlash card.
- An AC/DC transformer 9V 500mA (minimum)
- A CD with the TripleFSnifer software and documentation, the SpyBox firmware and documentaton.
- Optionally: a BlueHeat RS232/RS485/RS422 8-ports serial extension device, with its AC/DC transformer and documentation CD.

Chapter 3. Hardware description

3.1. Front side connectors



3.1.1. LPC : laboratory power connector

The laboratory power connector must be used in conjunction with the provided AC/DC transformer.

The nominal power is 9V DC 500 mA.

The polarity is (-) on the outside, (+) on the inside.

3.1.2. TPC : train power connector

The train power connector may be used when the SpyBox is located in a Train. The provided Phoenix connector ensures a better contact stability.

The nominal power is 9V to 30V DC Volts DC 500 mA.

3.1.3. SER : maintenance connector

Standard DB9 connector providing a RS232 serial connection.

3.1.4. LED : Status leds

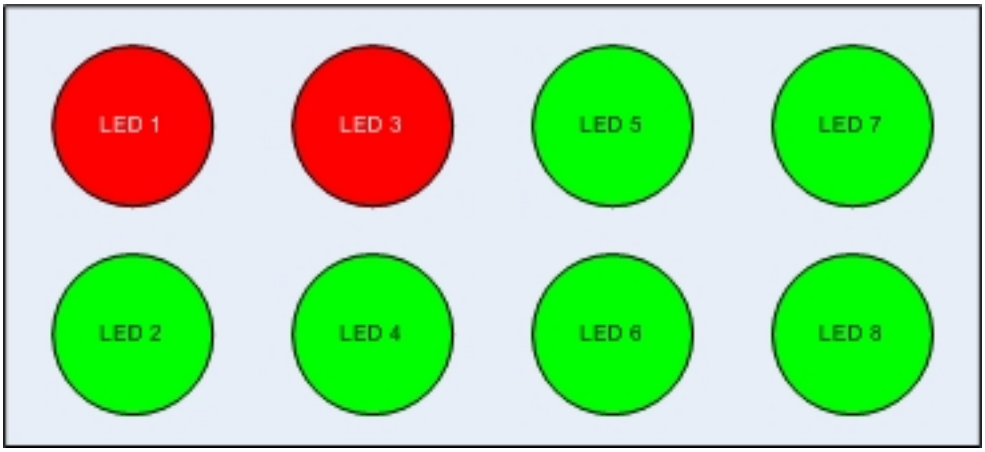
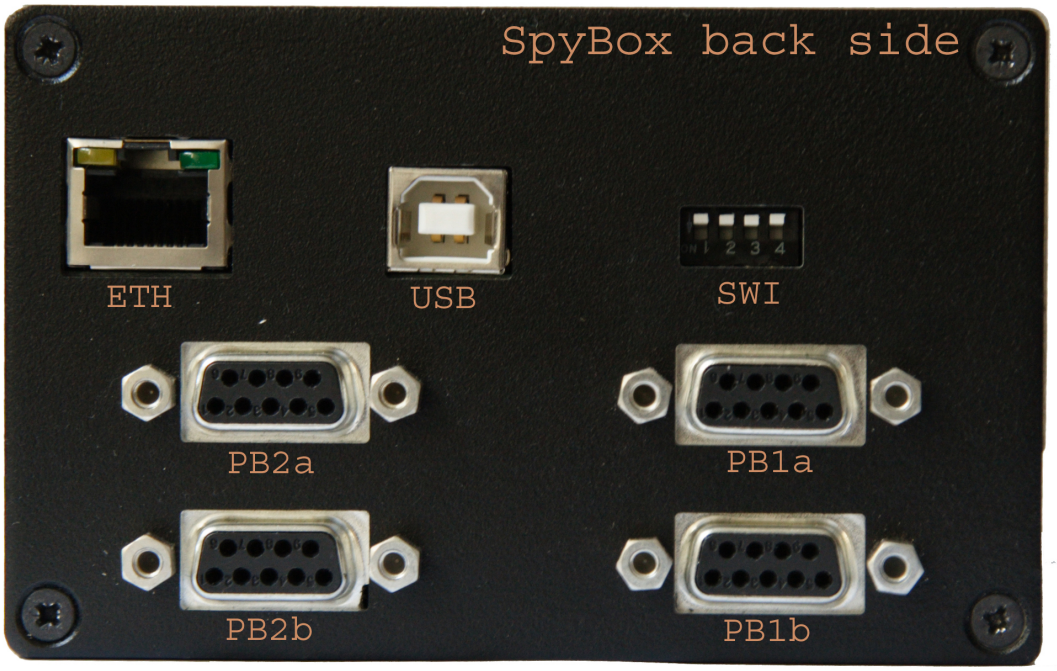


Table 3.1. Leds description

Number	Name	Off	On	Blinking
LED1	System Error		The Spybox controlling application has a severe error.	--
LED2	Power	Spybox is powered off	SpyBox is properly powered.	
LED3	CF Status		No CompactFlash card detected or CompactFash card not recognized	CompactFlash card is full
LED4	Euroradio			One euroradio frame has been recorded.
LED5	Data Transmit			A block of captured network activity is being send to the TrippleFSniffer
LED6	Profibus 2 activity	No activity on BUS 2	--	A block of captured network activity is being recorded on the CompactFhas card
LED7	Profibus 1 activity	No activity on BUS 1	--	Data is being acquired from BUS 1
LED8	Profibus 2 activity	No activity on BUS 2	--	Data is being acquired from BUS 2

3.2. Back side connectors



3.2.1. ETH : Ethernet connector

Standard RJ45 Ethernet connector. Used to control the Spybox and upload captured Profibus network data.

3.2.2. PB1a PB1b PB2a PB2b : Profibus connectors

The four Profibus connectors conform to the EN50170 standard.

PB1a and PB1b are two DB9 female connectors wrired in parallel to the same signals.

PB2a and PB2b are two DB9 female connectors wrired in parallel to the same signals.

There is no interconnection between any of the PB1 signals and any of the PB2 signals.

The SpyBox hardware does not provide terminator resistors.

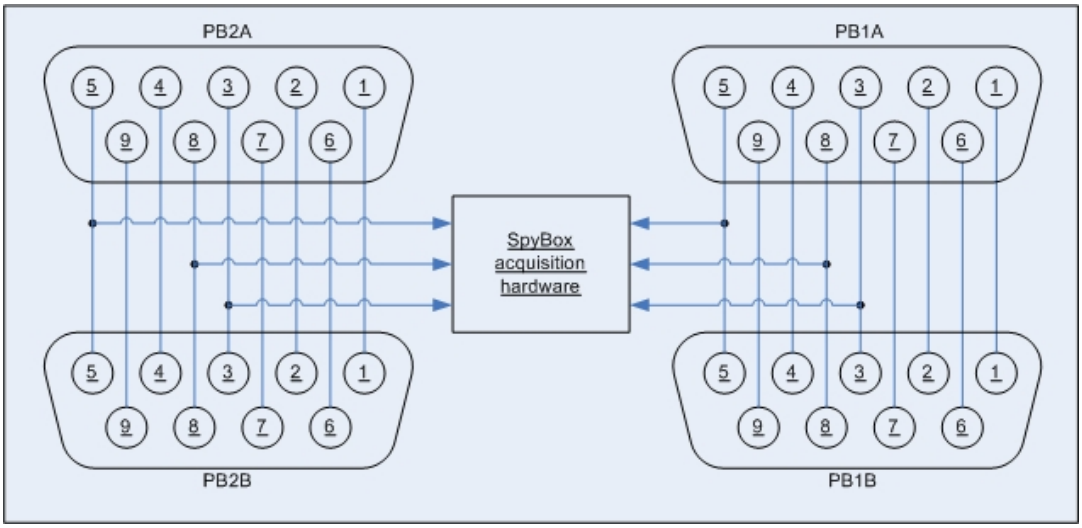


Table 3.2. Profibus connector wiring

#	EN 50170 signal name	SpyBox usage
1	SHIELD	unused
2	Minus 24V output voltage	unused
3	Receive/Transmit data P	acquired in conjunction with Receive/Transmit data N and Data ground
4	Control P	unused
5	Data Ground	acquired in conjunction with Receive/Transmit data P and N
6	Voltage Plus	unused
7	Plus 24V output voltage	unused
8	Receive/Transmit data P	acquired in conjunction with Receive/Transmit data P and Data ground
9	Control N	unused

3.2.3. USB : USB connector

USB Slave connector reserved for future extensions.

3.2.4. SWI : Dip switches

Table 3.3. DIP Switches description

#	Name	Description
1	reset	If set to ON, all the contents of the CompactFlash card are erased. User defined TCP/IP address, recording mode and previously captured Profibus messages are removed.
2	reserved	must be set to OFF
3	reserved	must be set to OFF
4	reserved	must be set to OFF

3.3. Internal Compact Flash Card

The CompactFlash slot is not accessible without opening the SpyBox.

Chapter 4. Profibus network data acquisition

This section describes how the SpyBox performs the Profibus network data acquisition

4.1. Introduction

The SpyBox uses a FPGA (Field Programmable Gate Array) to acquire and decode the Profibus signals. A line driver converts the differential RS485 signal pair into digital information. The FPGA samples this digital information and rebuilds Profibus frames according to EN50170 standard.

The FPGA SpyBox expects a SyncTime of 33 tbits.

After this SyncTime, the FPGA starts assembling characters, using 11 bits per character.

Every assembled character is paired with a character status indicating start-of-frame, parity-error, framing-error or end-of-frame conditions.

Received characters and their status are timestamped (with micro-second precision) and concatenated in a 4096 memory buffer.

The 4096 characters and statuses buffer is transmitted to the SpyBox Control application.

The SpyBox Control application filters the received characters if required (removing tokens or scans) and concatenates it with previous characters.

When the SpyBox Control application has 8192 characters available, they are commited to the current recording mode media:

- Ethernet connection when recording mode is *OnLine*
- CompactFlash card when recording mode is *OffLine*

This process is performed in parallel for both buses.

4.2. Filtering

A very important proportion of the Profibus frames transmitted on a Profibus network are related to the Profibus network management itself and do not carry much useful information for the ERTMS development, integration or maintenance teams.

The Profibus hardware components (Asics) do automatically send and receive these Profibus management frames without interfering with the upper user layers.

These frames (Tokens and Scans) may be safely removed from the captured traffic in order to highly reduced the size of TrippleFSniffer files and/or to increase the duration that can be recorded on the SpyBox CompactFlash card.

4.2.1. Profibus Tokens

Profibus tokens are continously exchanged by Profibus master stations.

A profibus token is made of 3 bytes **SD4 - DA - SA**

SD4 A constant value 0xDC

DA The physical address of the receiver

SA The physical address of the sender

4.2.2. Profibus Scans

Profibus scans are periodically sent by Profibus master stations in order to discover new Profibus Master stations.

A profibus scan is made of 3 bytes **SD4 - DA - SA - FC - FCS - ED**

SD4 A constant value 0xDC

DA The physical address of the receiver

SA The physical address of the sender

FC A Frame Control byte

FCS A Frame Check Sequance byte

ED A constant value end delimiter 0x16

4.2.3. Filtering benefits

The filtering benefits can be shown on a typical ERTMS network (single bus) setup:

- One EVC providing the SLL Reference clock twice per second.
- One EVC providing the odometry data (10 mesg/s) clock twice per second.
- Seven peer-to-peer connections.

The SpyBox recorded the profibus messages on this network for one hour.

Table 4.1. Filtering comparison

Filter	Duration	Messages	Bytes
None	1 hour	20.100.445 (100.0%)	255.219.426 (100.0%)
Filter tokens	1 hour	10.067.020 (50.0%)	144.851.751 (56.7%)
Filter tokens and scans	1 hour	192.600 (1.0%)	6.609.871 (2.5%)

This table shows that the ERTMS messages account for 1% of the total profibus messages (2.5% of the total size)

It also shows that a 256Mb CompactFlash card can record:

- 0h30 of all the profibus messages on 2 buses
- 1h00 of all the profibus messages on 1 bus
- 20h00 of ERTMS messages on 2 buses
- 40h00 of ERTMS messages on 1 bus

Chapter 5. SpyBox operating modes

This section describes the various SpyBox operating modes

5.1. OnLine recording

When *OnLine* recording mode is selected, the SpyBox aquires the Profibus and/or Euroradio traffic and sends it to the TrippleFSniffer through the ethernet link.

5.2. OffLine recording

When *OffLine* recording mode is selected, the SpyBox records the Profibus and/or Euroradio messages on the local CompactFlash card. All the CompactFlash card capacity is used.

In order to cope with different recording schemes, the OffLine recpording process uses the CompactFash capacity in two flavors:

- *Fixed Storage:* Recording starts at the beginning of the CompactFlash card end stops when all the available space is used. One front side LED indicates the CompactFlash card full condition.
- *Rotating Storage:* recording starts at the beginning of the CompactFlash card. When the end of the storage is reached, recording starts again at the beginning.

  The SpyBox controlling application is aware of the oldest and youngest locations used in the storage file.

  The SpyBox shall provide to the TrippleFSniffer a time coherent set of recorded Profibus messages when the Download is performed.

Chapter 6. Euroradio serial line data acquisition

This chapter describes how the SpyBox records data on the serial lines provided by the BlueHeat serial ports extension device.

6.1. Introduction

In order to capture the communications between a ERTMS Level 2 Train and the trackside, one can sit between the ETCS Onboard Unit and its GSM-R Modem(s). By using SpyCables (Y-Cables) to connect the ETCS and its modems, and connecting this SpyCables to the SPyBox, the SpyBox can monitor, for each serial line, independently of the wire protocol, the upstream and downstream data flow.

As each SpyCable (See cabling design here [http://www.ertmssolutions.com/sniffer/ch07s02.html]) needs two serial ports to connect to, we use an external extension device to cater for up to 8 serial ports. This device is explained in details in the next section. These 8 serial ports enable the SpyBox to simultaneously record information from up to 4 GSM-R Modems (Or actually any V.92 serial connection, as nothing in the SpyBox is specific for GSM-R.)

Serial communication capture supports the following features:

- Configurable baudrate
- Baudrate change on Data Carrier Detect (DCD) pin change.

If Baudrate change on DCD change is enabled, then the SpyBox will automatically adapt its recording baudrate to the DATA baudrate if DCD has switched to ON, and to COMMAND baudrate if DCD has switched to OFF. When the recording starts up, the baudrate matching the DCD state is selected (Respectively DATA for DCD ON and COMMAND for DCD OFF).

6.2. BlueHeat extension device

The BlueHeat extension device is an external hardware extension to the SpyBox. It provides 8 additional serial ports via a standard TCP/IP connection.

6.2.1. Description

This manual describes only the basics of the BlueHeat device prodedures. The complete BlueHeat user manual is included with the TripleF-Sinffer software distribution or available on the web (http://www.connecttech.com/pdf/manual_BN-v013.pdf). This user manual provides an exhaustive reference of the BlueHeat device.

The BlueHeat extension supports the following wire protocols:

- RS-232
- RS-485
- RS-422

6.2.2. SpyBox Setup for the BlueHeat

The SpyBox firmware will try to connect to a BlueHeat extension device when starting up if there is a blueheat configuration file present on its compact flash. By default, no configuration file is installed on the SpyBox. In order to install a blueheat configuration file, execute the following procedure:

- Make sure you run the SpyBox firmware >= version 1.4.0. If it is not the case, follow the firmware upgrade procedure.
- Adapt the file blueheat.conf.example located in the TripleF-Sniffer installation directory to use your BlueHeat device IP address. If you haven't changed it, you can leave the file blueheat.conf.example untouched. In order for the blueheat connection to work properly, it is very important to only modify the IP address values in each line of the configuration file. Changing other values may cause BlueHeat connectivity problems.
- Using your favorite FTP client, copy the blueheat.conf.example configuration file to the SpyBox, using the following parameters:
  - User: twin
  - Password: twinconfig
  - Destination path: /opt/cf/blueheat.conf
- Make sure your BlueHeat device is powered, connected on the same Local Area Network as the SpyBox. To verify that, try to ping the SpyBox and the BlueHeat extension, using their static IP addresses. Both should answer the ping requests.
- Remove the power plug from the SpyBox, replace it after at least one second. Once the SPyBox is up and running (I.e. you can connect it using the TripleF-Sniffer SpyBox administration dialogs), try to record some Euroradio traffic.

  Note: The boot sequence is very important: the BlueHeat device must be up and running before powering up the SpyBox, otherwise the SpyBox will not be able to connect properly to the BlueHeat during its boot sequence. To verify that the BlueHeat is up and running, the four leftmost red leds on its front panel must be ON (Power, CPU, 10/100 and Link).

6.2.3. Record RS-422 or RS-485 traffic

The SpyCable provided with the TrippleFSniffer is designed to record RS-232 connections. In order to record serial traffic using a different wire protocol (E.g. RS-485 or RS-422), the following procedure must be followed:

- Re-configure the BlueHeat device to use RS-485 or RS-422 wire protocol.
- Use a suitable SpyCable.

6.2.3.1. Re-configure the BlueHeat device to use RS-485 or RS-422 wire protocol

Connect to the BlueHeat Web Configuration Manager, using any web browser, with the following URL: http://192.168.0.211. The default administration user id is "wcm" and the password is "password". Once logged in, select the "Basic Serial Settings" link on the left side, and update the column "Mode" to the desired value.

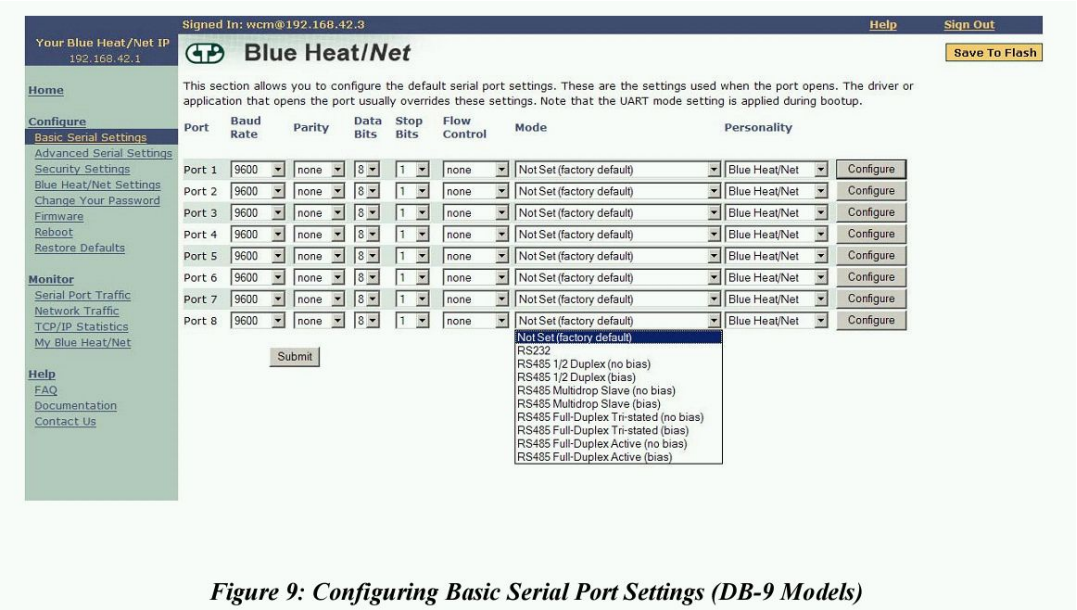
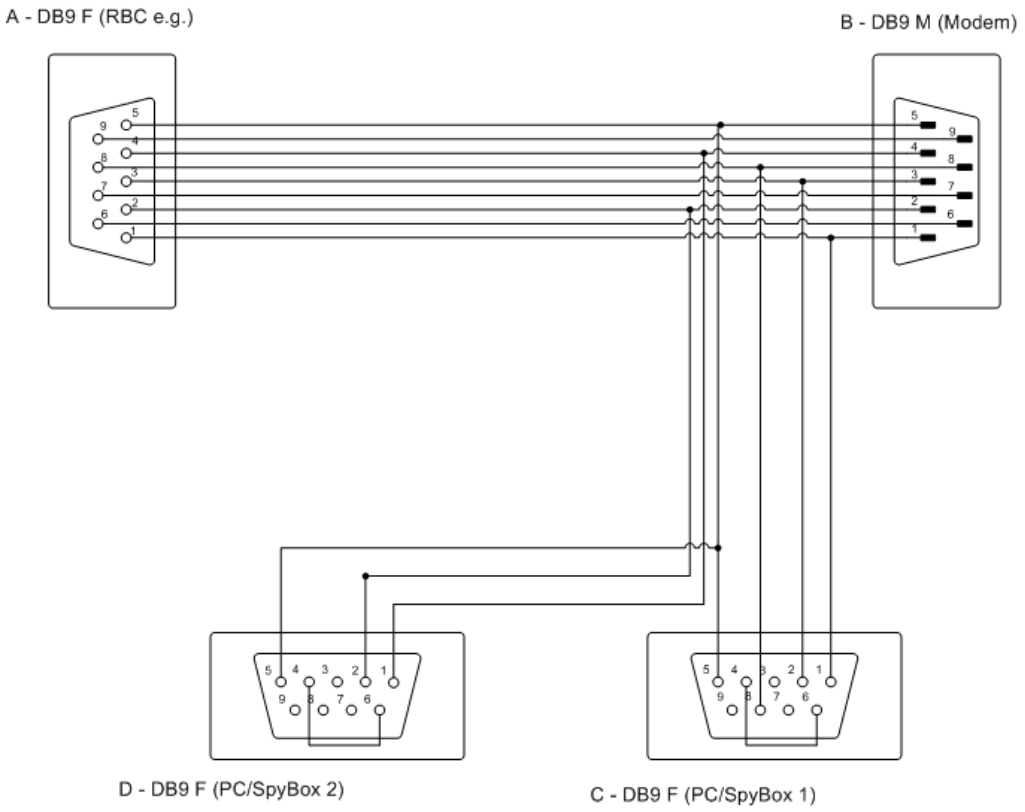


Figure 9: Configuring Basic Serial Port Settings (DB-9 Models)

6.2.3.2. Create a SpyCable suitable for RS-485 or rs-422 recording

The standard SpyCable design (See figure below) has four connectors: two connectors (A and B) that sit between the DCE and DTE, and two other connectors (C and D) are connected on the BlueHeat extension module, or on the PC where the TripleF-Sniffer software is installed.

SpyCable Schematics

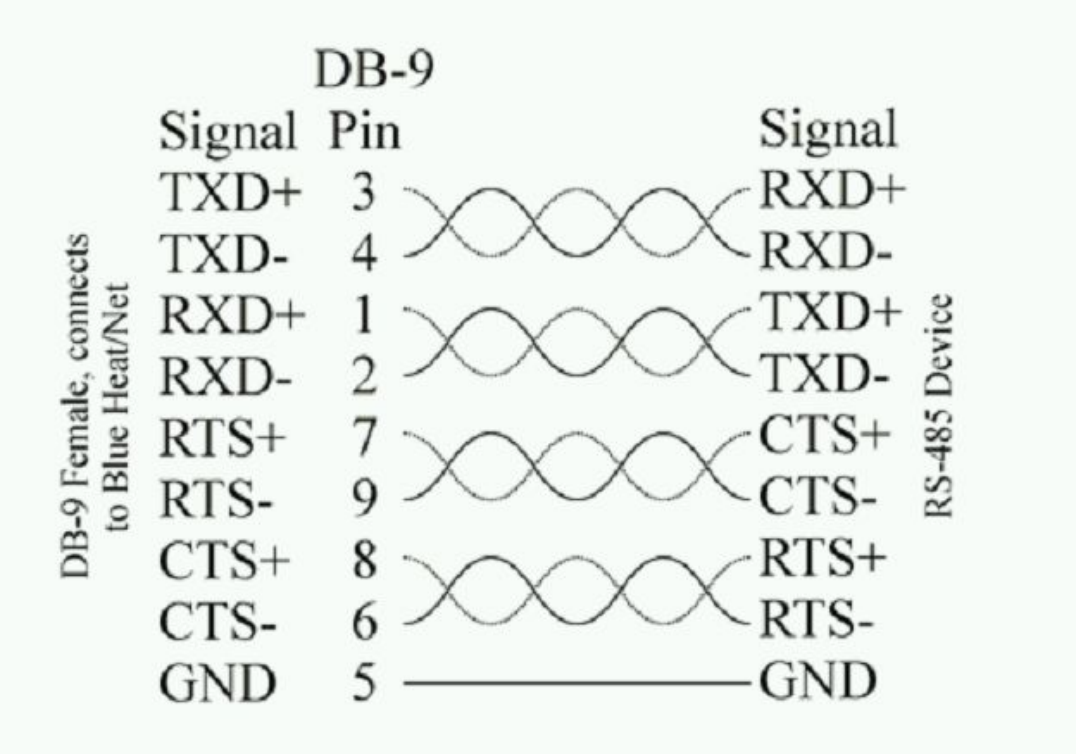


Connector	Direction	Short	Description
1	<	DCD	Data Carrier Detect
2	<	RX	Received Data
3	>	TX	Transmitted Data
4	>	DTR	Data Terminal Ready
5	<>	GND	Signal Ground
6	<	DSR	Data Set Ready
7	>	RTS	Request To Send
8	<	CTS	Clear To Send
9	<	RI	Ring Indicator

Version 1.01

In order to support RS-422 or RS-485 recording the connectors D and C must be adapted to the BlueHeat RS-422/RS-485 cabling requirements (Described in Pages 96 up to 98 from the BlueHeat user manual) while respecting the general SpyCable design: data transmitted from A to B goes to recording ending C, and data transmitted from B to A goes to recording ending D.

For example, if the desired wire protocol configuration is 4-wire RS-422 Full Duplex mode, endings D and C of the Spycable must comply the following schema:



In case of any question or problem regarding SpyCable settings, please contact support@ertmssolutions.com.

In the current SpyBox firmware version, the DCD signal is only taken into account for RS-232 configurations. For RS-485/422 configurations, CTS and RTS signals are not taken into account.

6.2.4. Miscelaneous

6.2.4.1. Change the BlueHeat static IP Address

In order for the SpyBox to be able to reach the BlueHeat extension, the BlueHeat must be configured with a fixed TCP/IP address. By default, the BlueHeat comes preconfigured with IP address 192.168.0.210. This IP address can be changed by connecting to the BlueHeat Web Configuration Manager, using any web browser, with the following URL: http://192.168.0.211. The default administration user id is "wcm" and the password is "password". Once logged in, select the "BlueHeat/Net Settings" link on the left side, and update the field Blue Heat/Net IP Address to the desired value.

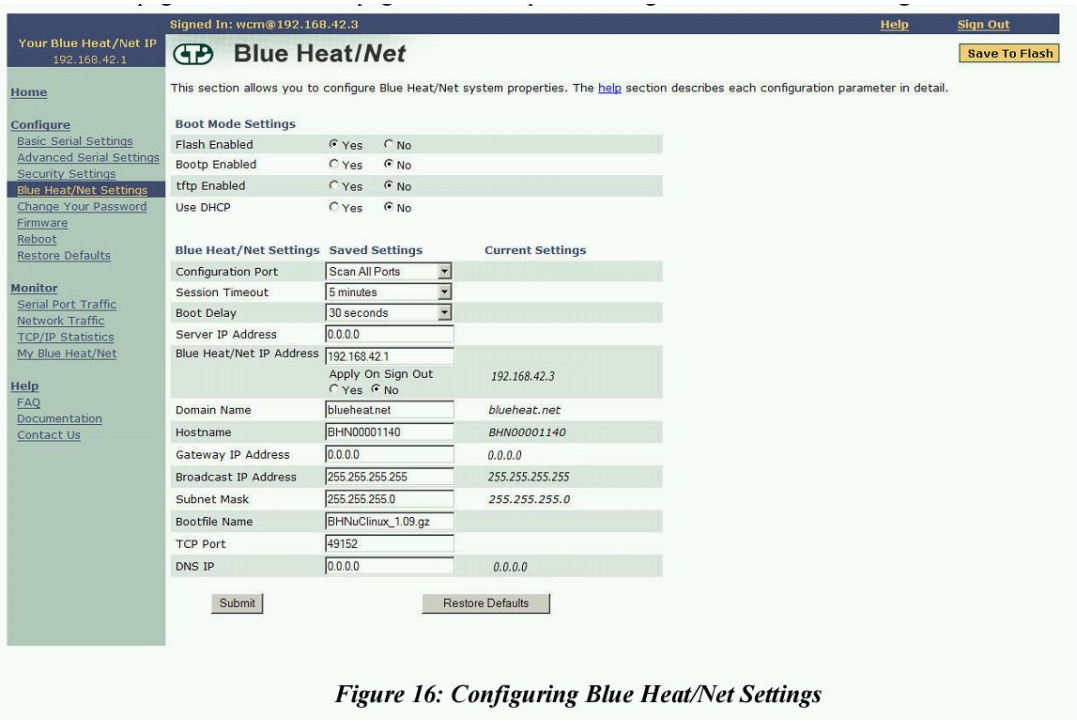


Figure 16: Configuring Blue Heat/Net Settings

6.3. Known issues

The following issues have been observed with the current SpyBox firmware:

6.3.1. Baudrate change interferences

When the spied modem change the state of the DCD flag, and the SpyBox is configured with different baudrates for COMMAND and DATA modes, then some interferences around baudrate changes have been observed. The serial data transmitted just before or after the DCD flag change can suffer from interferences, and be recorded incorrectly.

Chapter 7. Software upgrade

7.1. Introduction

The SpyBox firmware is stored in an internal Flash memory device.

The firmware is made of four parts wich can be separately upgraded:

- U-Boot : the bootloader that initializes the processor, loads the FPGA, loads the Linux kernel and the SpyBox control application
- U-Boot parameters : a consistent set of parameters used by the boot loader
- Linux Kernel : a compressed Linux kernel image
- Linux filesystem and application : the Linux filesystem and the SpyBox controlling application

In order to upgrade the SpyBox firmware, one must use a strict procedure:

- Step 1 : Unpack the SpyBox firmware
- Step 2 : Start a TFTP server
- Step 3 : Connect to the SpyBox
- Step 4 : Open a U-BOOT session
- Step 5 : Test the Ethernet connection
- Step 6 : Upgrade the whole firmware
- Step 7 : Reset the SpyBox

The software upgrade is driven by user commands entered in a serial terminal emulator running on the PC connected to the SpyBox with a serial (RS232) cable.

The updated firmware is downloaded by the SpyBox through the Ethernet link with the help of a **T**rivial **F**ile **T**ransfer **P**rotocol server running on the PC.

7.2. Step 1 : Unpack the firmware upgrade

ERTMS Solutions provides SpyBox firmware upgrades in a compressed archive (ZIP) containing a coherent set of individual parts.

- ramdisk.img

  The Linux file system and the SpyBox controlling application.

- vmlinux-prod-q105.img

  The Linux kernel

All parts must be upgraded at the same time.

Unpack the firmware upgrade ZipFile (spybox_firmware_x_y_z.zip) to some folder.

7.3. Step 2 : Start a TFTP server

The U-BOOT boot loader uses the Ethernet connection and the TFTP protocol in order to upload the firmware. you must install a TFTP server on your host PC or have a local network TFTP server available.

ERTMS Solutions recommends a simple, effective and freely available TFTP server made by SolarWinds [http://www.solarwinds.net].

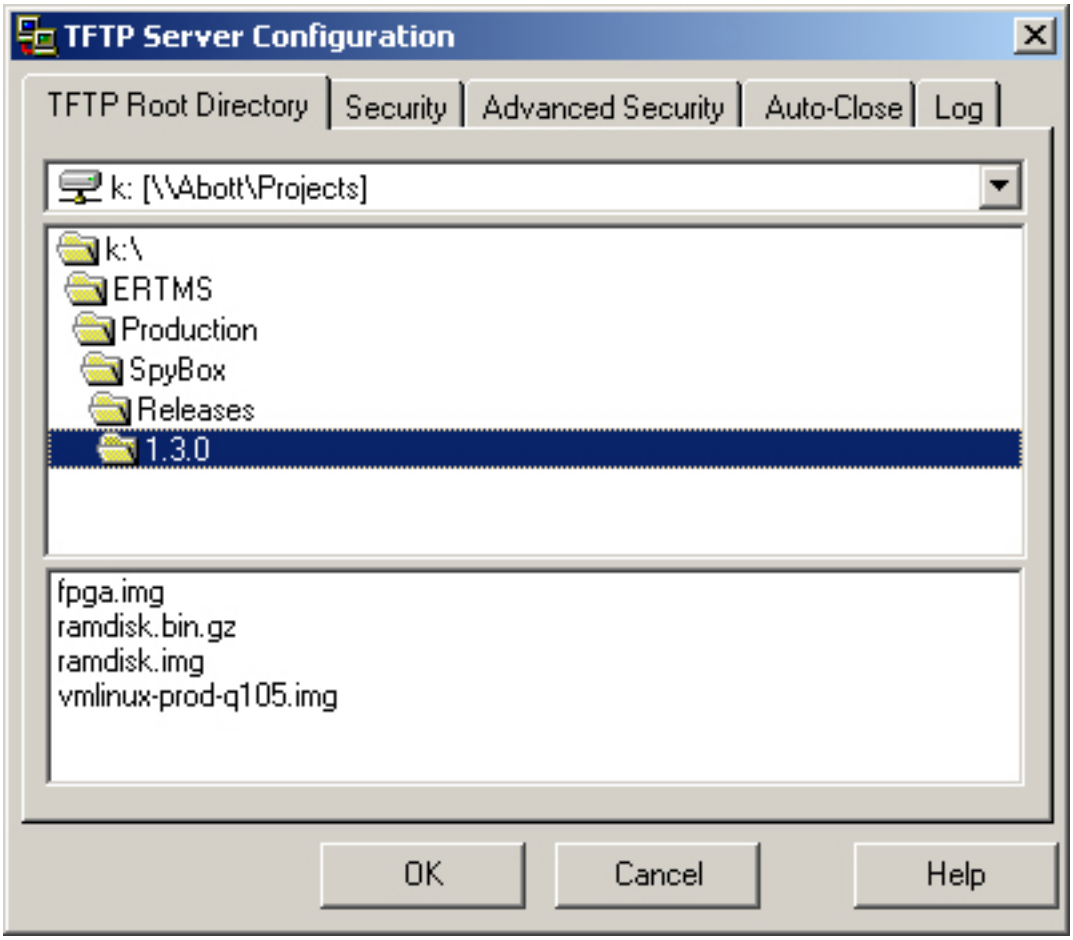
The SolarWinds free TFTP Server is available here [http://www.solarwinds.net/Tools/Free_tools/TFTP_Server].

7.3.1. Configure the SolarWinds TFTP server

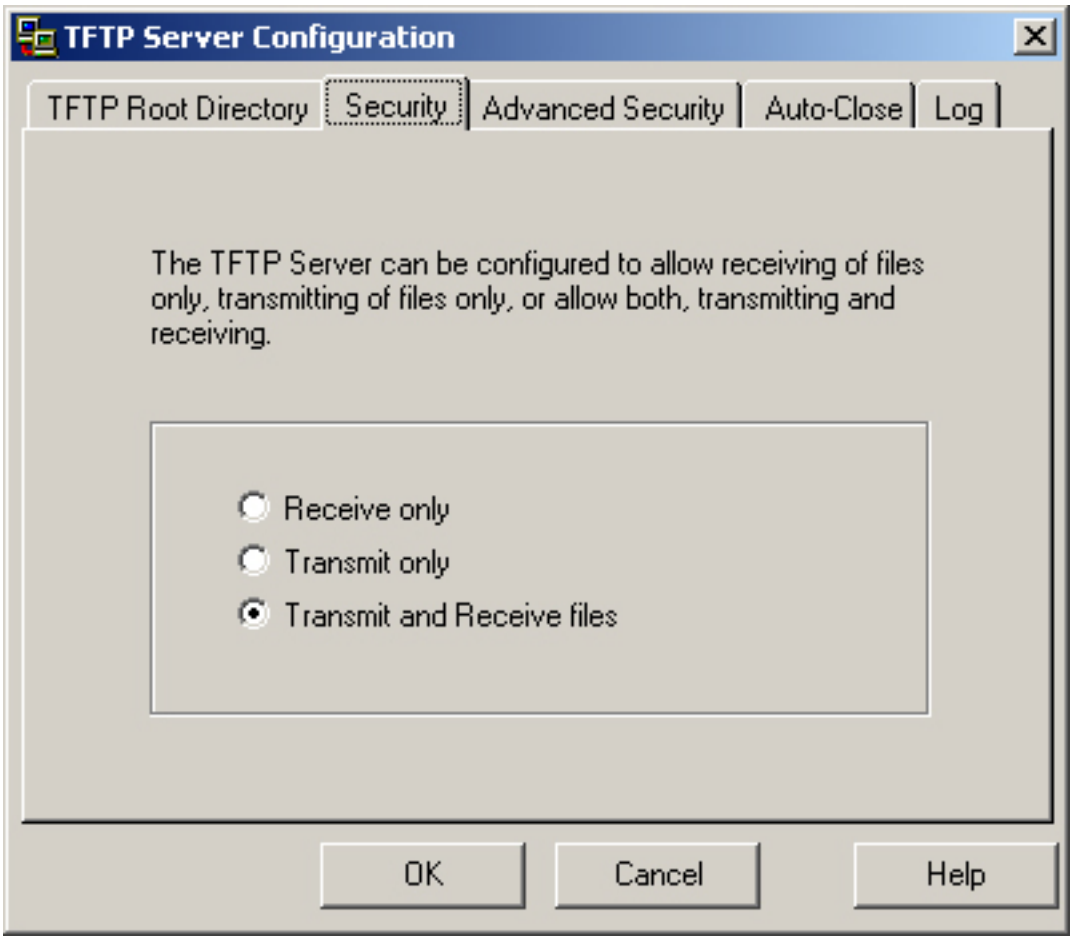
The SolarWinds TFTP server allows TFTP clients (like the SpyBox) to download files from a single directory.

The TFTP server must be configured to download files from the directory where the Spybox firmware was unzipped (see Step 1)

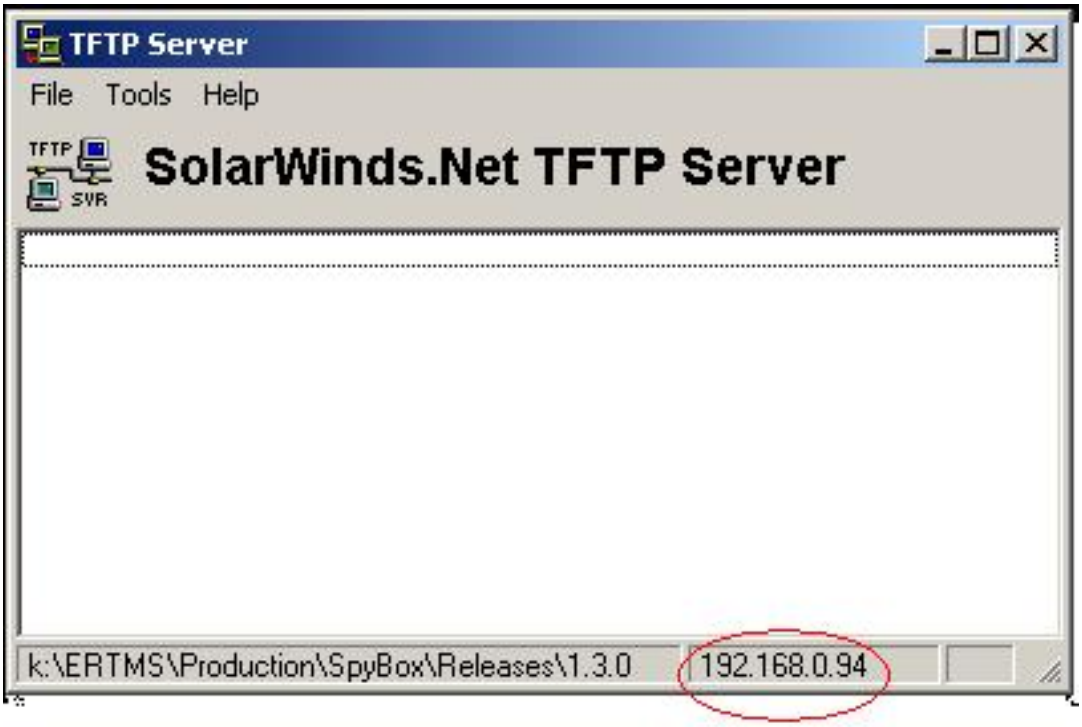
Open the Solarwinds TFTP server : File # Configure and select the directory where the Spybox firmware upgrade was unzipped.



In the same dialog, into the *Security* pane, ensure the TFTP server is configured to Transmit and receive files.



Once the configuration dialog is closed, the Solarwinds TFTP server shows the default screen:



Write down the IP address of the TFTP server (192.168.0.94 in our example), it shall be used in Step 4

7.4. Step 3 : Connect to the SpyBox

Connect the SpyBox maintenance connector to the COM1 or COM2 serial port in the host PC.

Open a terminal emulation on the host PC

Serial settings are:

- 115200 bauds
- 8 data bits
- Parity None
- 1 stop bit
- No hardware checking

Ensure the connection is properly established by powering the SpyBox: clear text, although cryptic, must appear on the terminal emulation program.

7.5. Step 4 : Open a U-BOOT session

The U-BOOT boot loader starts immediately after when SpyBox is powered.

In order to upgrade the firmlware, the boot process must be interrupted.

One seconds after the power on, the U-BOOT boot loader makes a short pause. If the right password (twin) is entered at the host PC at this time, the boot loader stops the automated boot process and enters an interactive mode.

Power on the SpyBox, and immediately type *twin* at the PC keyboard, the following prompt should appear:

Example 7.1. U-Boot sample output

```
EXPEVT_=00000000
INTEVT =00000000
INTEVT2=00000000
interrupt_init
board_init
PHIDANI
Env is at a0070000
Loading FPGA ...
Verifying Checksum ...
Set program mode
Wait INIT (a400013a)
Programming 54908 bytes from a0030040..............
Wait DONE
S2 successfuly programmed
baudrate_init

U-Boot 1.0.0-pre (Sep 23 2005 - 17:53:04)

Flash: 32 MB
IDE:
```

```
In:    serial
Out:   serial
Err:   serial
=>
```

Ensure the terminal emulation is working properly by issuing the command 'version' followed by RETURN.

Example 7.2. U-Boot version command

```
=>version
U-Boot 1.0.0-pre (Sep 23 2005 - 17:53:04)
```

U-Boot needs to know the TFTP server IP address and its own IP address. These two adresses are defined by issuing two U-Boot commands : **setenv ipaddr** and **setenv serverip**.

Change the TFTP server address to the IP address of your actual TFTP server, the host PC if you are using SolarWinds TFTP server (see Step 2)

setenv serverip the_ip_address_of_your_tftp_server

Change the SpyBox IP address to one that is compatible with your local settings. This address is teporary and shall not be used after the software upgrade is finished.

setenv ipaddr the_ip_address_you_choose_for_the_spybox

Ensure all adresses are correct by issuing

printenv

7.6. Step 5 : Test the Ethernet connection

Connect the SpyBox ethernet connector to the host PC with a crosslinked cable or to your local LAN with a standard Ethernet RJ45 cable.

Ensure the SpyBox is able to download the Linux kernel image from the TFPT server. This step does not upgrade the software, it only makes a download test to the SpyBox RAM.

tftpboot 0x0C300000 vmlinux-prod-q105.img

The U-BOot output should ressemble to this

Example 7.3. U-Boot downloading a file

```
=> tftpboot 0x0C300000 ramdisk.img
MAC address is 00:50:c2:1c:7e:32
TFTP from server 192.168.0.94; our IP address is 192.168.0.
Filename 'ramdisk.img'.
Load address: 0xc300000
Loading: ##################################################
#################################################################
#################################################################
#################################################################
```

```
#################################################################
#################################################################
#################################################################
#################################################################
#########################################################
done
Bytes transferred = 2943943 (2cebc7 hex)
```

7.7. Step 6 : Upgrade the whole firmware

Update the FPGA

run reprogfpga

Update the Linux Kernel

run reproglin

Update the Linux File System

run reprogrd

These 3 commands produce a relatively similar output. Here is an example of a successfull update of the Linux file system.

Example 7.4. U-Boot updating the Linux file system

```
=> run reprogrd
MAC address is 00:50:c2:1c:7e:32
Can't overwrite "ethaddr"
TFTP from server 192.168.0.94; our IP address is 192.168.0.
Filename 'ramdisk.img'.
Load address: 0xc300000
Loading: #################################################################
#################################################################
#################################################################
#################################################################
#################################################################
#################################################################
#################################################################
#########################################################
done
Bytes transferred = 2943943 (2cebc7 hex)
Un-Protected 128 sectors

.................................................................
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.................................................................
Erased 128 sectors
Copy to Flash... done
```

```
Protected 128 sectors
=>
```

When U-Boot arrives at the stage of copying the downloaded image to the internal Flash Memory (**Copy to Flash... done**) the process may appear as frozen because not output is produced for a relatively long time (tens of seconds).

This behaviour is natural and care must be taken not to interrupt this process by any mean.

7.8. Step 7 : Reset the SpyBox

Unplug the SpyBow power chord and plug it back.

The SpyBox is ready for use after 30 seconds.

Chapter 8. How To

8.1. How to create a Telnet console

The SpyBox embedded Linux runs a standard Telnet server.

A Telnet console can be created with any standard Telnet client software.

```
telnet 10.10.10.0
```

Ensure you use the actual TCP/IP address instead of the example one (10.10.10.0)

The telnet login name is *twin*.

The telnet password is *twinconfig*.

8.2. How to create a Serial console

Open a terminal emulation on the host PC

Serial settings are:

- 115200 bauds
- 8 data bits
- Parity None
- 1 stop bit
- No hardware checking

Ensure the SpyBox is up and running.

Ensure no one is using the SpyBox.

Abort the current running SpyBox application by pressing ctrl-c on the host PC terminal emulation software.

8.3. Change the SpyBox TCP/IP address.

The SpyBox embedded Linux uses the TCPIP address defined in the factory settings configuration file (/etc/init.d/network.conf).

Before reading this file, the boot process looks for a user defined TCP/IP address in a file located into the CompactFlash card (/opt/cf/sb_net.txt).

In order to use a different TCP/IP address, one must create this user configuration file in the proper location.

This file must be created with a console access on the SpyBox.

Choose one of the two available methods to open a console on the SpyBox:

- Telnet
- Serial

Once the console is activated, apply the following procedure.

1. Move to CompactFash card directory

```
cd /opt/cf
```

2. Overwrite the default TCP/IP address

```
echo "IPADDRESS=10.10.10.0"     >sb_net.txt
echo "NETMASK=255.255.255.0"   >>sb_net.txt
echo "IPTYPE=static"           >>sb_net.txt
```

   Ensure you type your selected TCP/IP address instead of the example one (10.10.10.0)

   Ensure you type your selected TCP/IP net mask instead of the example one (255.255.255.0)

   Take care of the redirection characters ">".

3. Flush system buffers

   Before rebooting, it is mandatory to synchronize the CompactFlash card with the Linux internal buffers.

```
sync
```

4. Restart the SpyBox

   Remove the power cord and plug it after one seond.

   The new TCP/IP address is in use.

Chapter 9. Reference

9.1. Default settings

9.1.1. TCP/IP address

The default (factory settings) TCP/IP address is *192.168.0.200*

9.1.2. Recording mode

The default recording mode is *.OnLine*